Thought Question

Consider the following pair of sentences:

The cop shot the spy with the gun.
The cop arrested the spy with the stolen documents.

What does a serial, bottom-up model predict about how these sentences should be parsed (interpreted) and what behavioral consequences that should have?

Language II

Production and Thought

Production

Basic facts about speaking

- Fluent speakers produce 2-3 words / second
- People know roughly 50,000 words.
- Error rate is ~1-2 / 1000 produced words.

Processes in speech production

- Decide what to say
- Select words with appropriate meanings
- Organize words into grammatical form
- Turn sentences into speech

How to study speech production

- One way is to look at speech errors.

Freud on speech errors

Speech errors "arise from the concurrent action - or perhaps rather, the mutually opposing action - of two different intentions" (Freud, 1916-1917).

"She's my breast … my BEST friend."

Cognitive account

- Speech errors reveal the processes going on as language output is planned.

Types of Speech Errors

- Sound Exchanges
  Night life
  Nife lite
  Beast of burden
  Burst of beaden
  Coin toss
  Toin coss
- Anticipation Errors
  Take my bike
  Bake my bike
- Perseveration Errors
  Beef noodle
  Beef needle
- Blends
  Tab (taxi/cab)

Levels of slips

- Errors happen at different linguistic levels:
  - Sound errors
    - rack pat (pack rat)
  - Morpheme errors
    - self-destruction instruct (self-destruct instruction)
  - Word errors
    - writing a mother to my letter (writing a letter to my mother)

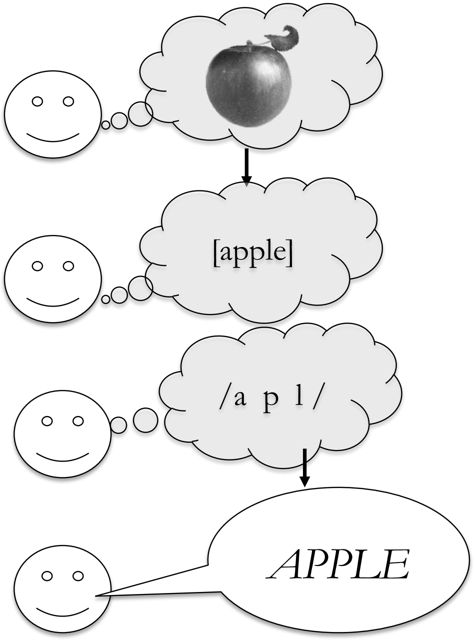
Garrett 1975

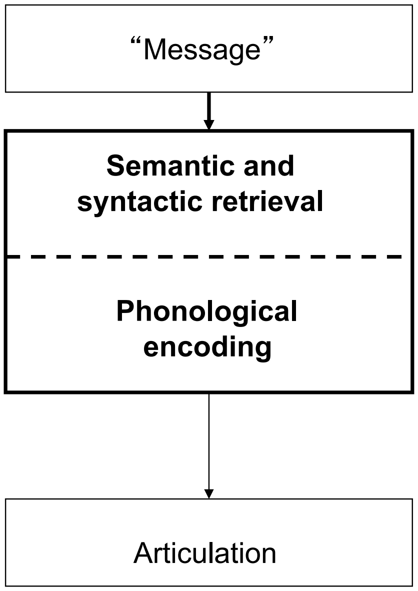
- Word and sound errors act differently:
  - Word exchanges ("write a mother to my letter")
    - span some distance
    - respect grammatical category and function
  - Sound exchanges ("rack pat")
    - occur mostly between nearby words
    - tend NOT to occur across phrases
    - do not respect grammatical category or function

Garrett 1975

- Implication: two separate processing levels:
  - one level for syntactic functions
  - one level for ordering (e.g., morphemes, phonemes).

Discrete two-step model of speaking (e.g., Levelt, 1989)





“Message”

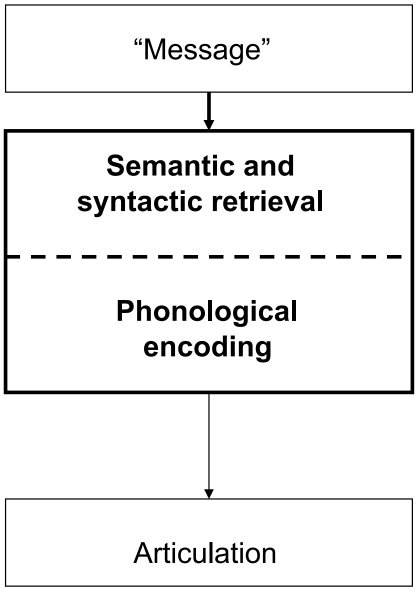
Semantic and syntactic retrieval

Phonological encoding

Articulation

Discrete two-step model of speaking (e.g., Levelt, 1989)

- Two separate stages:
    - retrieve semantic and syntactic information about words
    - determine their phonological form
- Serial and discrete:
    - first, semantic/syntactic retrieval
    - then phonological encoding
- Unidirectional: no feedback from phonological onto the semantic layer



“Message”

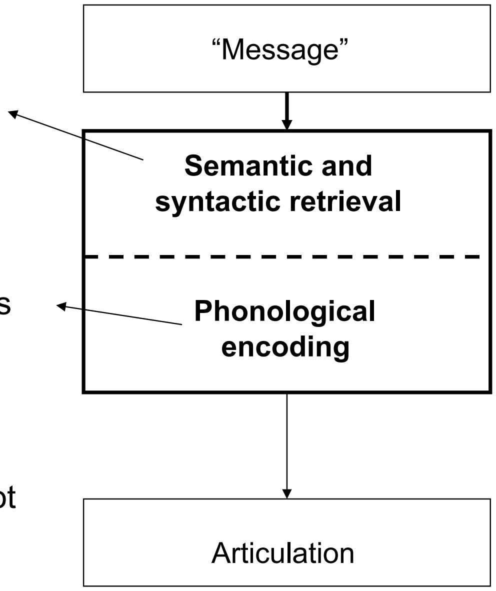
Semantic and syntactic retrieval

Phonological encoding

Articulation

Discrete two-step model of speaking (e.g., Levelt, 1989)

- Errors in first stage: word errors
  - can occur at a distance as you are building whole message
  - should respect syntax
- Errors in second stage: sound errors
  - happen as message is transformed into sound
  - since happens linearly, errors should occur close by
  - syntax and semantics should not matter
- **Prediction: Meaning and sound errors are independent**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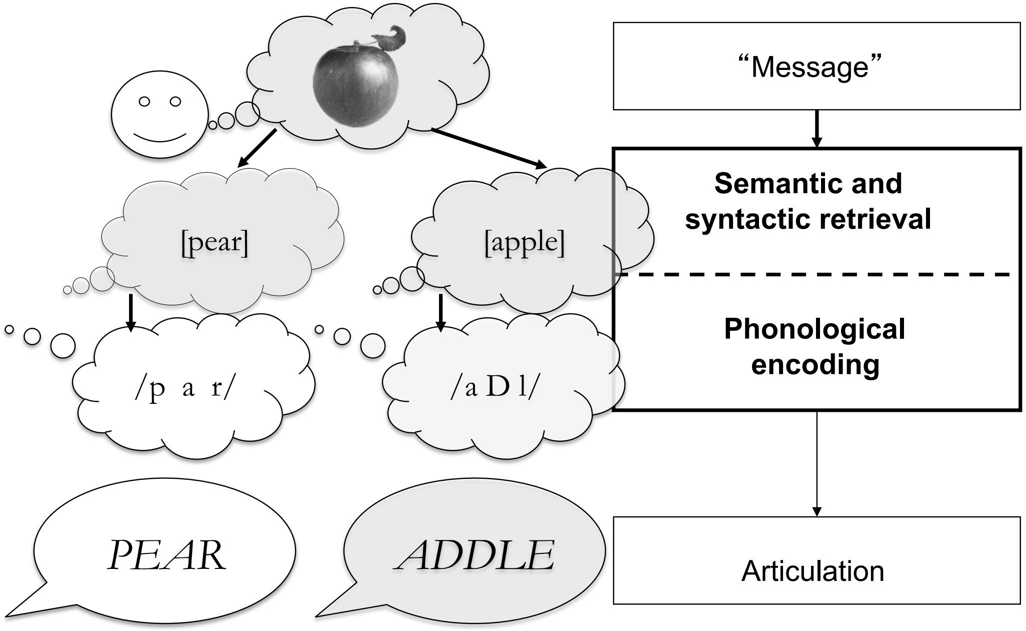

“Message”

Semantic and syntactic retrieval

Phonological encoding

Articulation

What happens if sound substitutions are independent of words/meaning?

- I want to say “speech”– but at the sound level, an error occurs:
- beach, ceech, deech, feech, geech, heech, jeech, leech, meech, neech, peach, queech, reach, seech, teach, veech, weech, yeech, zeech, etc.
- So, if I grab a random sounds accidentally, most of the time the error I make will not be a word (and certainly not related in meaning).

Analyzing speech errors **(Dell & Reich, 1981)**

- “Lexical bias” - tendency for errors to create words rather than nonwords:
  - “hold card cash” (cold hard cash) likely
  - “weautiful boman” (beautiful woman) less likely
- “Mixed errors” - tendency to produce errors that are semantically AND phonologically related to the intended word
  - “apricot” instead of “apple”
- Neither finding accords with the serial model.
  - sound and meaning should be independent

Interpretation?

- Suggests that semantic and phonological retrieval must be interacting.
- Perhaps selection of sounds feeds back to the earlier level and biases selection of words

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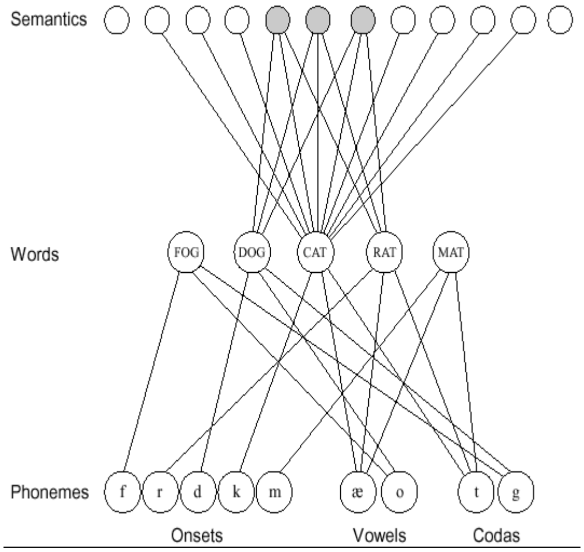
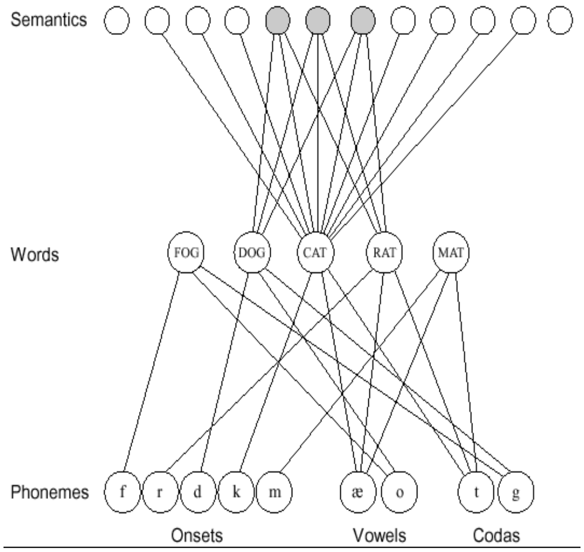
Interactive activation model of speaking (Dell, 1986)

- PDP model with layers of nodes corresponding to semantic features, words, and phonemes.
- All connections are bidirectional.
- Activation spreads through the network.
- Word node that receives the highest activation is selected.
- Phonemes that receive the highest activation are selected.



Interactive activation model of speaking (Dell, 1986)



- Semantics of CAT turns on word node corresponding to “cat”
- Also gives some activation to words for related concepts (“dog”, “rat”)
- The word “cat” turns on the corresponding phonological nodes (*k, ae,* and *t)*
- Phonological nodes feed back activation to the word layer, strengthening “cat” and turning on “rat” and “mat”
- “cat” should be most active, followed by “rat” which gets activation from semantics and phonology.

Interactive activation model (Dell, 1986)

How does this model account for the findings?

- **Lexical bias**:
  - Output is determined by selecting the phonemes with the highest activation level
  - Likely to be one that has top-down activation from a word node

Interactive activation model (Dell, 1986)

- **Mixed errors**:
  - Activation flows in both directions.
  - Word selection is influenced by top-down semantic information AND by backward activation from the phonological level.
  - “Mixed” errors receive both top-down and bottom-up activation, and are thus more likely to be erroneously selected

Problems with natural speech errors

- Report of errors depends on listener judgments
  - some errors have higher detection rates than others
  - errors can be hard to classify
  - many - theoretically important - error types are extremely rare

Speech errors in the lab

Read the following pairs of words silently to yourself. When you see words in yellow, say them aloud AS QUICKLY AS POSSIBLE.

ball dome

beak doll

bus door

bell dark

darn bore

Speech errors in the lab

- Baars, Motley, & MacKay (1975)
  - Subjects are asked to silently read word pairs.
  - Occasionally, they are cued to read aloud as quickly as possible:

Priming trials:	`ball`	`dome`
	`beak`	`doll`
	`bus`	`door`
	`bell`	`dark`
Critical trial:	**`darn`**	**`bore`**

Speech errors in the lab

- Baars, Motley, & MacKay (1975)

Priming trials:	`ball`	`dome`
	`beak`	`doll`
	`bus`	`door`
	`bell`	`dark`
Critical trial:	**`darn`**	**`bore`**

➢In trials like these, exchange errors (“barn door”) occur on about 30% of the trials.

Speech errors in the lab

Priming trials:	`big dutch`
	`bang doll`
	`bill deal`
	`bark dog`
Critical trial:	**`dart board`**

- The error “bart doard” occurs only about 10% of the time (compared with 30% for last set).
- “Lexical bias” again. Finding coincides with results from speech error collections.

Summary

- Speaking involves various “stages”
  - figure out message
  - find words
  - structure words
  - choose sounds
  - produce sounds
- Question is how those stages occur
  - discrete/serial?
  - interactive?

Summary

- Look at error patterns.
  - naturally occurring
  - elicited in lab
- Overall, supports idea of multiple stages.
- But some error types are unusually frequent:
  - errors that make words
  - errors that are related in sound and meaning
- Suggests interaction between semantic, word, and phonological stages.

Language and Thought

Does language shape thought?

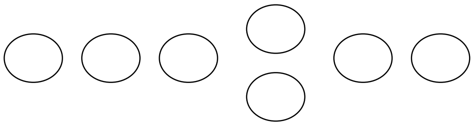
- Edward Sapir (1884-1939)
  "Human beings…are very much at the mercy of the particular language which has become the medium of expression for their society…the 'real world' is to a large extent unconsciously built upon the language habits of the group."
- Benjamin Whorf (1897-1941)
  "We dissect nature along lines laid down by our native language…The world is presented in a kaleidoscopic flux of impressions which has to be organized by our minds-this means largely by the linguistic systems in our minds."

Sapir-Whorf hypothesis

- Strong version: language ***determines*** thought
  - Can't think things that you don't have words for.
  - Too strong; language is flexible
    - Kiriwina has word "mokita" which means "the truth that everyone knows but that no one talks about"
    - Can express in English, though no specific word
- Weak version: language favors some thought processes over others
  - Will tend to think in ways your language suggests
  - Implications for, e.g., sexist language

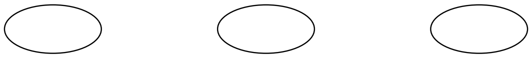
Testing the hypothesis: color

- English has many color terms.
- Other languages have as few as two.
  - Dani of Indonesia
    - mili (dark)
    - mola (light)
- In general, very predictable across languages.



Testing the hypothesis: color

- If the Sapir-Whorf hypothesis is correct, expect that perception of/memory for color should be different for Dani speakers and English speakers.
- Test two groups using color chips --



  - naming colors different (e.g., amount of agreement)
  - but memory for colors very similar
    - make same kind of errors
    - do best for the same (prototypical) colors

Testing the hypothesis: color

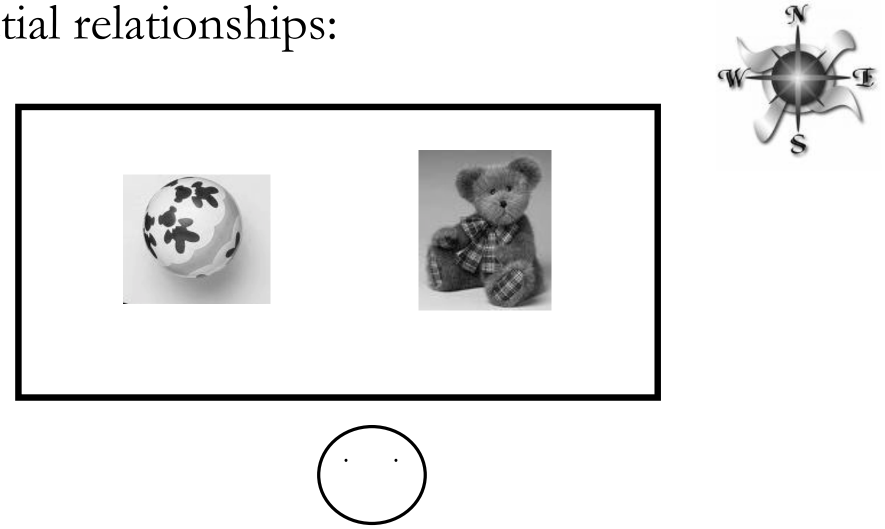
- Results do not support Sapir-Whorf hypothesis.
- But color may be a bad choice -- strong biological component.

Spatial cognition & language

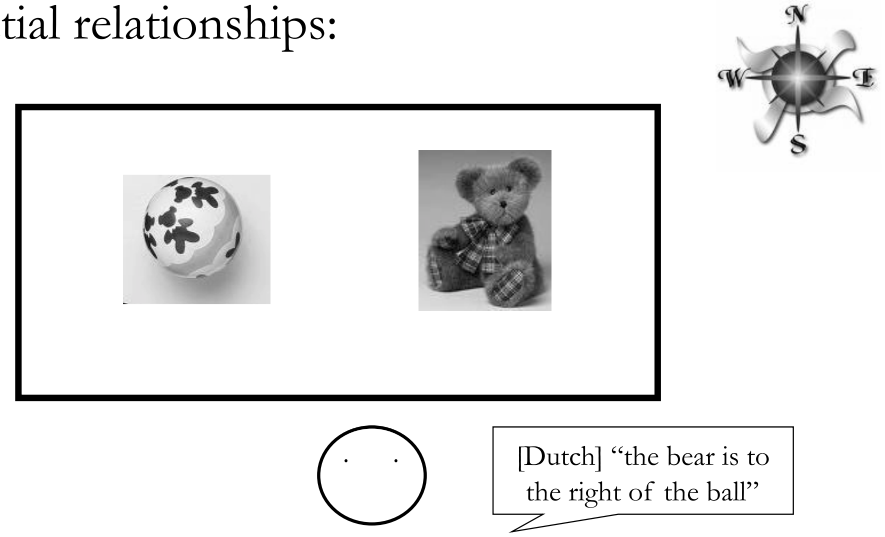
- In Dutch (the Netherlands)
  - space is described with respect to objects
    - "*Espresso Royale is to the left of H.O.G.*"

- In Tzeltal (Mayan language spoken in Chiapas, Mexico)
  - spatial descriptions reference cardinal directions, and layout of space
    - uphill = "south"
    - downhill = "north"
    - "*Espresso Royale is North of Psychology*"

- Spatial relationships:

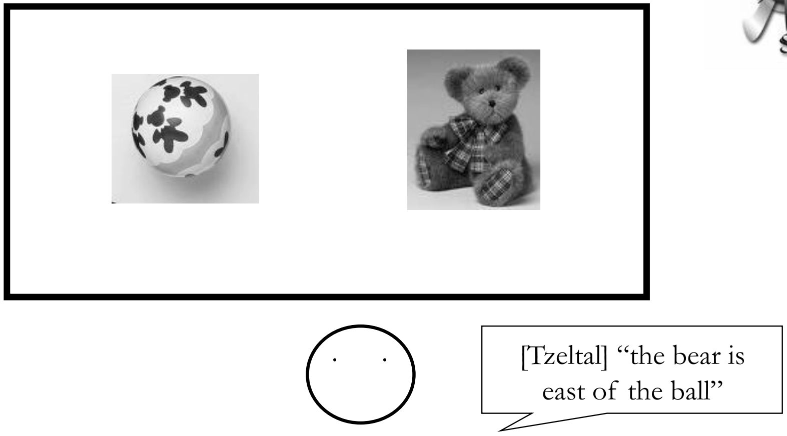


- Spatial relationships:



[Dutch] "the bear is to the right of the ball"

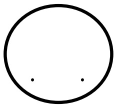
- Spatial relationships:

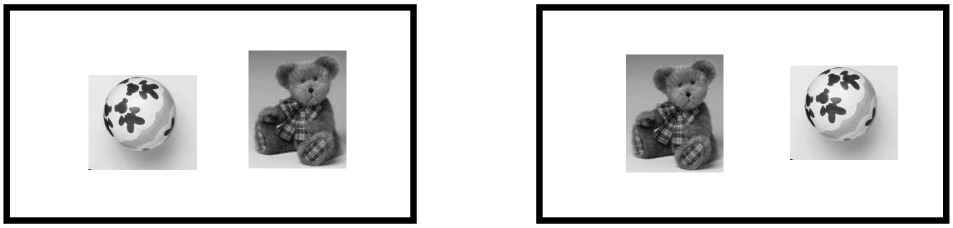


[Tzeltal] “the bear is east of the ball”

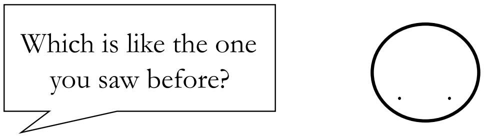
- Spatial relationships:

Which is like the one you saw before?





- Spatial relationships: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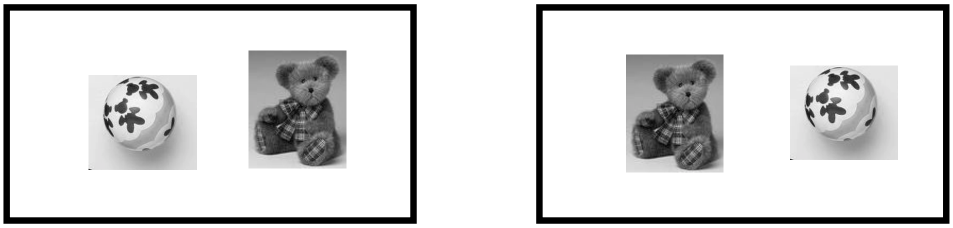
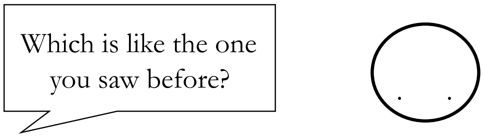


Dutch speakers:
THIS ONE (bear to right of ball)

- Spatial relationships: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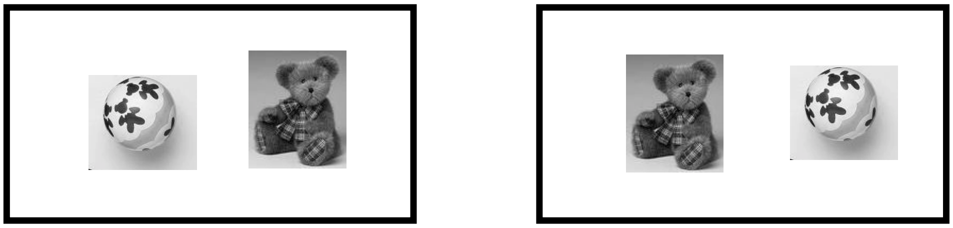
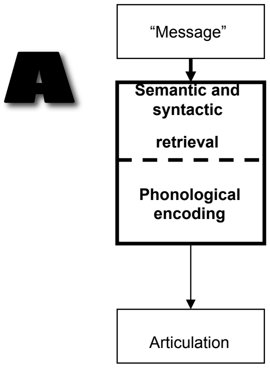
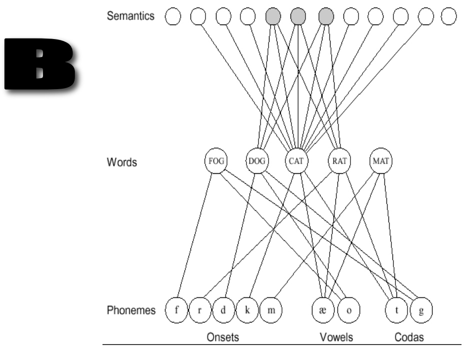


Tzeltal speakers:
THIS ONE (bear east of ball)

Summary

- Language and thought are often closely related.
  - our thought processes get reflected in our language
  - we use linguistic codes to help us think
- But language is flexible enough not to constrain thought, as strongest versions of the Sapir-Whorf hypothesis would suggest.
- However, language can make information more or less accessible, and having verbal labels can influence perception, learning, memory, and decision making some tasks.





Consider the following two models of speech production. Which model(s) would predict (reasonable levels of) each of the following error types:

(1) semantic errors (say "dog" instead of "cat")
(2) non-lexical phonological errors (say "gat" instead of "cat")
(3) lexical phonological errors (say "mat" instead of "cat")
(4) mixed phonological and semantic errors (say "rat" instead of "cat")